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TITLE: Device for the pre-programmable infusion of liquids

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Detailed Description Text - DETX (2):
In FIG. 1, an external programming device is indicated at I, a control installation at II, and the microdosing unit at III. The individual devices I and II are briefly connected mechanically and electrically solely for the purpose of transferring the program, whereas the individual devices II and III are connected for the continuing signal transmission upon the functioning of the microdosing unit. Thereby, the signal transmission ensues via a direct line or wirelessly by means of remote control. In particular, in the sample embodiment according to FIG. 1, an inductive signal transmission is applied.
The device I contains a housing 1 with an electrical distributor, in particular, a crosspoint distributor. The reference numeral 2 characterizes the programming array of the signal distributor. Further, visual and control **display** units 3 and 4 and a programming plug 5 are arranged on the housing 1.
The device II consists of the housing 6, which exhibits an external plug socket 7 which fits with the plug 5. The housing 6 comprises, as its essential component part, a memory 8 for storing the daily program pre-programmed by

means of the programming device I. The program memory 8 has a quartz clock 9
allocated to it as a timer, as well as a signal coder 10 with a transmitter 11
connected on its output side and a transmission coil 12 connected on its output
side, by means of which the signal polled from the program memory is prepared
for transmission. The transmission coil 12 extends about the entire perimeter
of the base of the housing 6 and is indicated at the opposite corners as a
section.

Detailed Description Text - DETX (4):

In FIG. 2, the programming device (corresponding to device I of FIG. 1) is
shown with a housing 28 and a program plug 29 and comprises the electrical or,
respectively, electronic component parts 30 through 60 in the circuit described
as follows: a read path 31, which consists of a rate-binary transducer 32 and a
level coverter 33 connected on its output side, is allocated to an electric
crosspoint distributor 30. Via a control logic 34, which is driven by a pulse
generator 35 for the generation of working and shift pulses, the electrical
signal value that was manually adjusted on the crosspoint distributor 30 is
tapped by means of shift registers and transduced into a binary signal by means
of transducer 32. By means of level converter 33, the binary signal is matched
to the required signal level, which can then be directly registered by the
control device II. The electric signal values manually adjusted on the
crosspoint distributor 30 are further delivered to a unit 36 for dosage
display. This unit 36 consists, in detail, of a digital adding circuit 37 with
a distributor and driver 38 as an adapter part and **display** unit 39 connected on
the output side. Thus, the summed, pre-programmed daily amount is digitally

indicated in insulin units on the **display** unit 39. By means of key 40, the **display** can be reset to zero. Further, a pulse for a unit 41 for time **display** is tapped from the generator 35, which unit 41 consists of a driver 42 as an adapter part with a digital **display** 43 connected on its output side.

Detailed Description Text - DETX (5):

The daily profile of the dosing that is manually pre-programmed on the crosspoint distributor or is stored in the memory of the control installation, respectively, can upon need be recorded as an analog signal on an external logger, which is indicated with the reference 44. To that end, either a read-out path 46 which can be connected to the memory of the control device and consists in detail of a level converter 47 with a rate-current transducer 48 connected on its output side or a rate-current transducer 49 that is connected directly to the crosspoint distributor 30 is connected to the measuring unit of the logger 44 via an analog switch 45. Thereby, the time feed of the logger 44 is synchronously driven by the unit 50. A synchronization unit 51 serves the purpose of synchronizing of the program predetermined by means of the crosspoint distributor 30 and, if necessary, stored in the memory of the control device. Further, the programming device according to FIG. 2 exhibits actuation switches 52 and 53 which influence the generator 35 for the generation of the shift pulse or the unit 50 for controlling the logger, respectively, via the command memories 54 and 55. By means of switches 52 and 53, the logic circuit described can be controlled in such manner that entire daily profiles or individual time steps can be selectively read into or out of the memory of the control device II. Further, via switch

53, the quartz clock
of the control device II is adjusted to the actual time of day. The switch 53
is designed as a touch contact, whereby, upon actuation, the **display** 41 and the
quartz clock of the control devices II corresponding to the time grid of the
crosspoint distributor 30 are keyed forward respectively by thirty minutes.
Reference numeral 56 indicates a switch for switching on the current supply of
the device for the above-described functions. To this end, the device also has
a unit for current supply 57 allocated to it, which consists of an accumulator
58 with voltage monitor and **display** unit 59 as well as a unit for voltage
stabilization 60.

Detailed Description Text - DETX (7):

In the specific sample embodiment according to FIG. 4, the pump drive
control 81 for the microdosing unit is integrated into the control device. The
signal of the gate circuit 78 sets a monostable flip-flop 82 for the generation
of a motor pulse. Via a driver stage 83, a step motor 84 is driven as the
drive of a pump, which, for example, is a roller pump. Thereby, by means of
the step motor 84, the pump drive for the roller pump is set in motion in
detail, whereby the course of the pump rollers is monitored by means of the
closing of a reed contact 85. By means of the alarm part 86, the function of
the microdosing unit III can now be monitored. The monostable flip-flop 87,
upon the running of the step motor 84, generates rectangular pulses that
correspond to the motor frequency f, which rectangular pulses are displayed as
pulses on a **display** unit 88. The rectangular pulses are simultaneously
delivered to a further divider and counter stage 89 and counted. Since the
number of the pulses generated by means of the reed contact

85 are correlated with the number of the step motor pulses in a correct running of the roller pump, the pump function can be audited by means of the comparison of the step motor pulses generated by the control device with the pulses of the reed contact 85. Under certain conditions, upon decoding in the recognition unit 90, a mechanical defect of the roller pump--in which the pump drive indeed receives step motor pulses but in which no roller movement ensues--is displayed at the **display** unit 91. The signal pulses generated by the reed contact 85 are further delivered to a divider and counter stage 92, which is always automatically set to zero at the beginning of the day by the frequency divider 74 of the quartz clock 73. The number of the reed pulses is a direct measure for the amount of liquid delivered; thus--given a corresponding calibration in insulin units--the number of insulin units actually delivered by the microdosing unit can be audited. Since, by means of the microdosing unit III, a predetermined total infusion amount for a patient in insulin units per day is not supposed to be exceeded, when such is the case, after decoding the signal by means of unit 93, an alarm is displayed on the **display** unit 94. In addition, the alarm part 86 exhibits a **display** unit 96 for the voltage stage of the battery 95 of the microdosing unit. An acoustic alarm emitter 97 for generating a beep is allocated to the **display** units 91, 94 and 96.

Detailed Description Text - DETX (8):

In FIG. 4, the external programming device is indicated with 100. It is designed about in the form of a typewriter, whereby a programming panel 101 with 48 columns and 7 rows occupies the operating plane. With such a

programming panel 101, thus, 7 discrete infusion installments with a time grid of 30 minutes per column can be adjusted. Below the programming panel 101, there is a signal band 102 allocated to the 48 columns of the programming panel 101, upon which the physician can pre-program signals which signal the patient as an acoustical signal at a predetermined time of day for the ingestion of meals, etc. On the console-shaped part, digital **display** units 103, 104 for displaying the time of day and the total daily dosage as well as, if necessary, further control units and operating elements are arranged. The horizontal surface of the console part exhibits a receptacle 105 for the control installation in the device housing 106, into which, upon program read-in or, reading-out of the program, the control device 106 is manually inserted and electrically connected by means of the programming plug. After insertion of the control device 106, an automatic time synchronization between the control device 106 and the programming device 100 ensues.

Detailed Description Text - DETX (9):

In further practical embodiment, the control device 106 exhibits an operating element 107 with which, via a potentiometer, a calibration of the relative amplitudes of the delivery rate pre-programmed by means of the programming device 100 can ensue in absolute insulin units (IE) per hour. With this operating element 107, the patient can himself change the level of the daily dosage in an emergency and adjust the pre-programmed delivery rate to an altered situation. Further, a **display** field 108 for optical alarm **display** in case of malfunction is arranged on the control device 106. The control device 106 is shown connected with the microdosing unit 111 via an electrical cable

109. The microdosing unit 111 and the control device 106 each have releasable
cable connections 110, so that the control device 106 and the microdosing unit
111 are not connected during the program loading from program device 100. A
logger 112 for the analog **display** of the control program manually inserted on
the crosspoint distributor 101 of the programming device 100 or, respectively,
for reading-out the program stored in the control device 106 is allocated to
the programming device 100. An ordinary time recorder can be used as the
logger 112.